Jet Propulsion Laboratory
California Institute of Technology

Ground-Based Diurnal Measurements of NO_2 and NO_3 in Support of SAGE-III/ISS Validation

Thomas J. Pongetti[1], Stanley P. Sander[1,2], King-Fai Li[3], Yangcheng Luo[2], Yuk L. Yung[2], Kimberlee Dube[5], Fedele Colosimo[4], Zhao-Cheng Zeng[2,4], Steven S. Brown[6] and the SAGE-III/ISS Algorithm Team[7]

[1]JPL/Caltech, [2]Caltech, [3]UC Riverside,[4]UCLA, [5]USaskatchewan, [6]NOAA, [7]NASA/Langley

Objectives

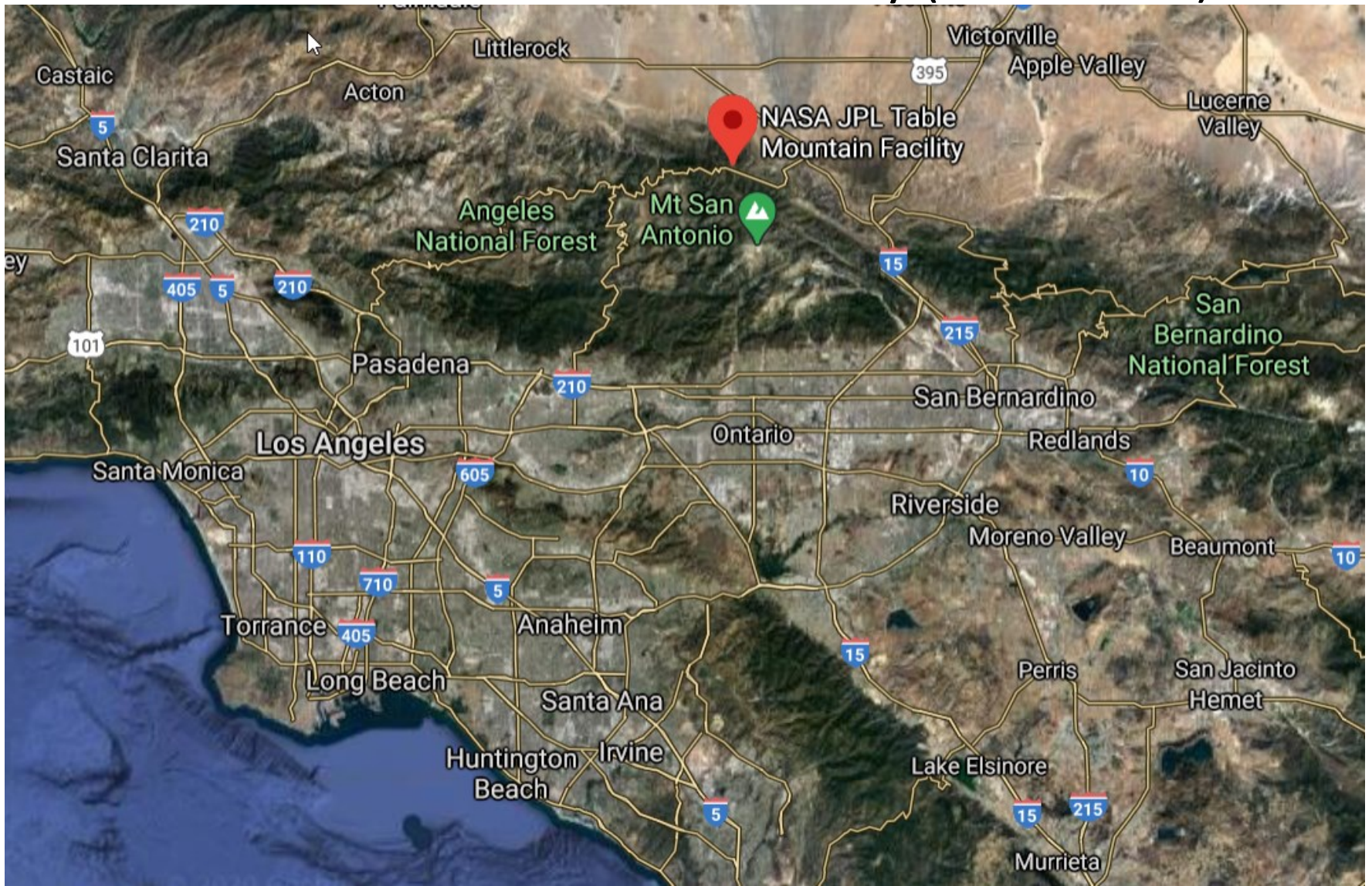
Objective 1: Obtain 24 hour measurements of NO_3 and NO_2 from Table Mountain Facility in support of SAGE III/ISS validation.

Objective 2: Analyze comparisons with coincident SAGE III/ISS measurements and work with the algorithm and science teams to interpret the comparisons and incorporate improvements into retrieval algorithms.

Roles		
Stanley P. Sander, JPL/Caltech	Data Acquisition / Analysis	Principal Investigator
Thomas J. Pongetti, JPL	Data Acquisition / Analysis	Co-Investigator
Yuk L. Yung, Caltech	1-D Modeling	Co-Investigator
King-Fai Li, UCR	1-D Modeling	Collaborator
Zhao-Cheng Zeng, UCLA/Caltech	Retrievals	Collaborator
Yangcheng Luo, Caltech	Radiative transfer / Retrievals	Collaborator

Ground-Based Diurnal Measurements of NO_2 and NO_3

Direct Solar/Lunar and Sky light Spectroscopy at JPL Table Mountain Facility (2.3 km ASL)



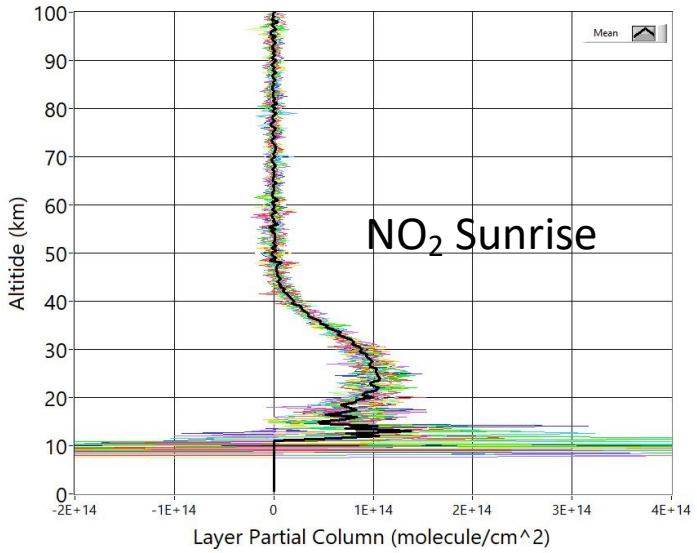
Issues Confronting Ground-Based Comparisons with SAGE III

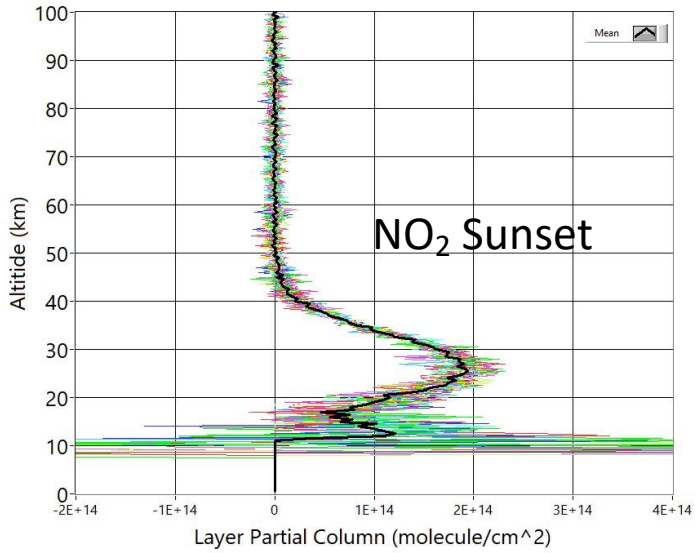
- Lower limit of SAGE III vertical profiles is 12-15 km (due to large uncertainty only 17 km and above are used)
- Ground-based occultations extend from 2.3 km to TOA

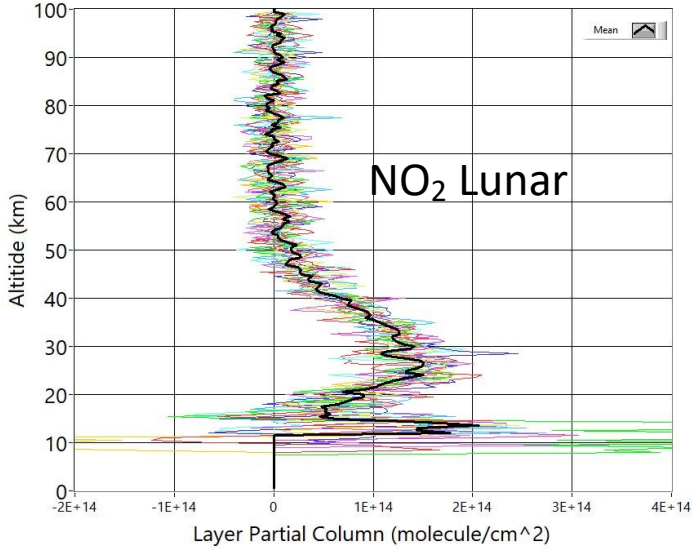
- SAGE III solar occultations occur at sun rise/set
  - Diurnal Corrections described in Dubè et. al. have been used in this comparison
  - **We have implemented an additional measurement capability of zenith sky light to capture rise and set times which allows for a full 24 hour measurement of NO2 (Radiative transfer model used to find zenith sky airmass factors)**

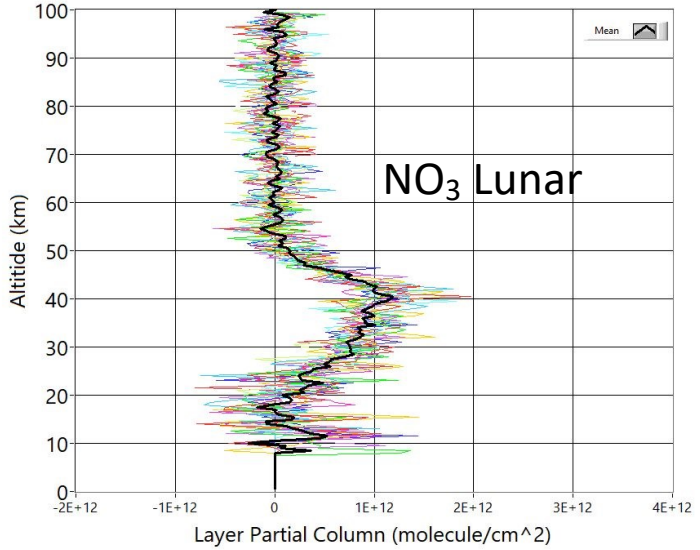
- Both SAGE III and ground-based lunar occultations occur over a range of local times

MUGS Comparisons with SAGE-III/ISS





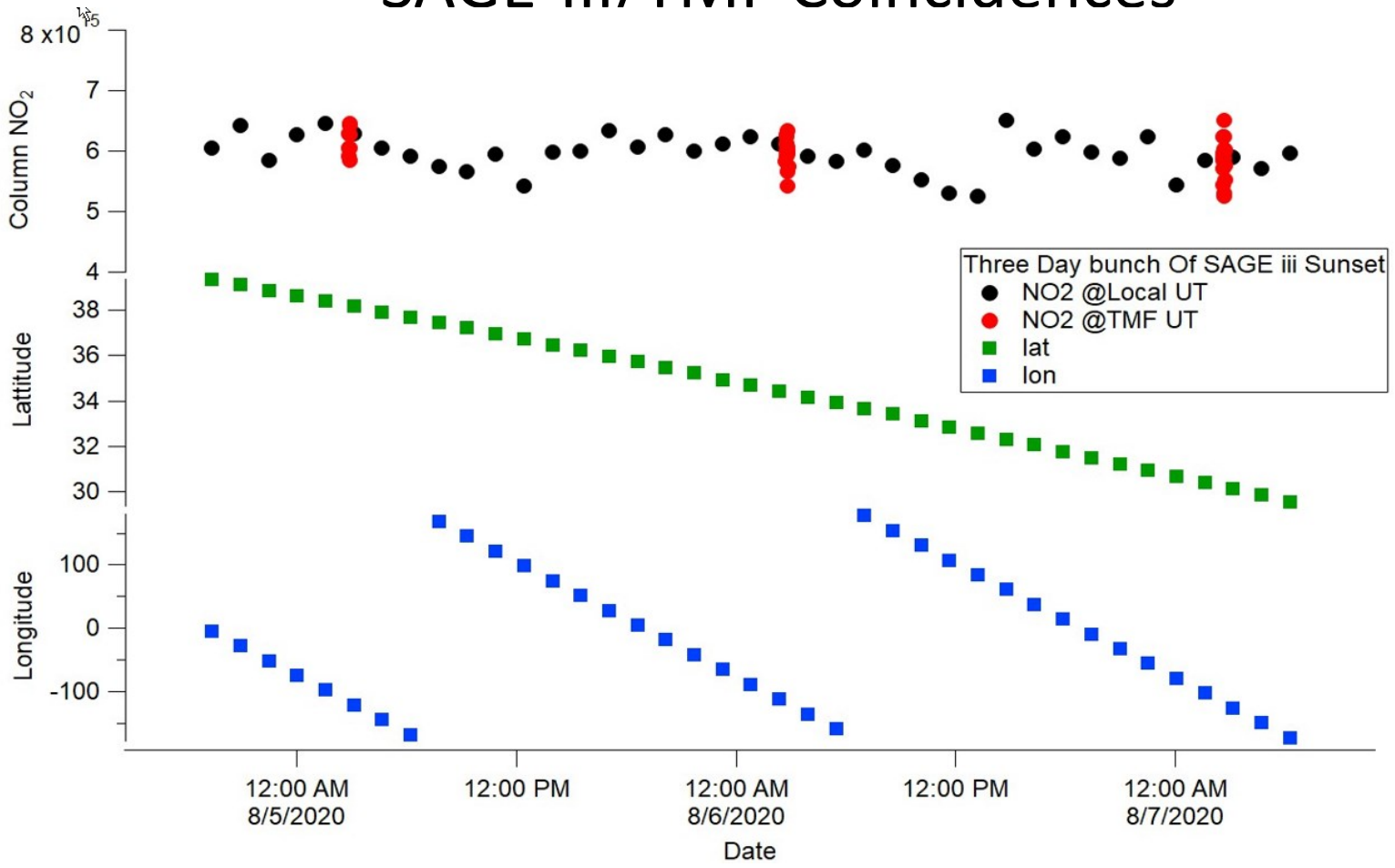




(SAGE III/ISS Profile Examples taken from single day from +/- 10°)

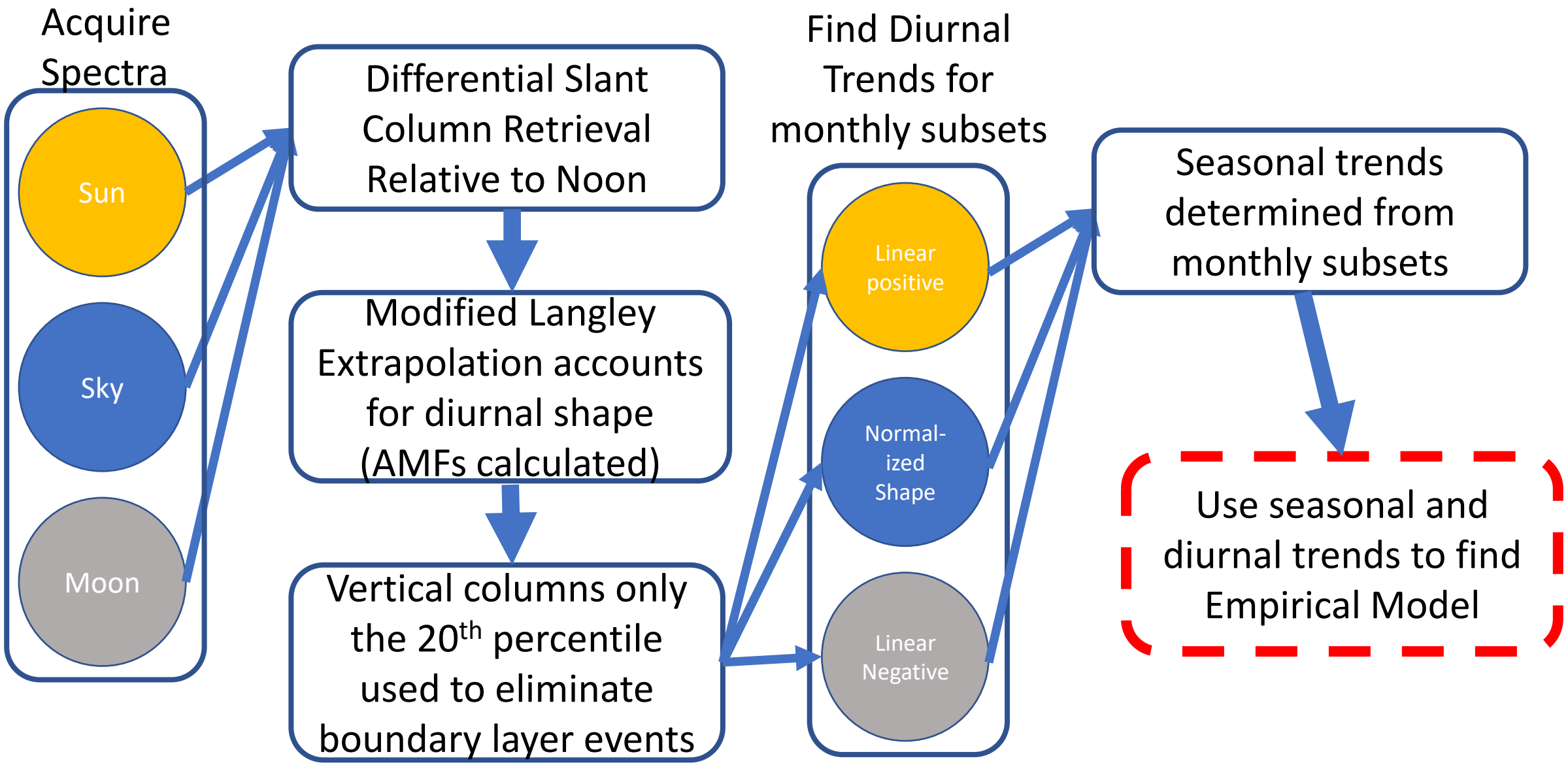
	Latitude Band	Number of Coincidence
NO_2 Sunrise	+/- 1°	333
NO_2 Sunset	+/- 1°	328
NO_2 Lunar	+/- 5°	366
NO_3 Lunar	+/- 5°	366

SAGE-III/TMF Coincidences

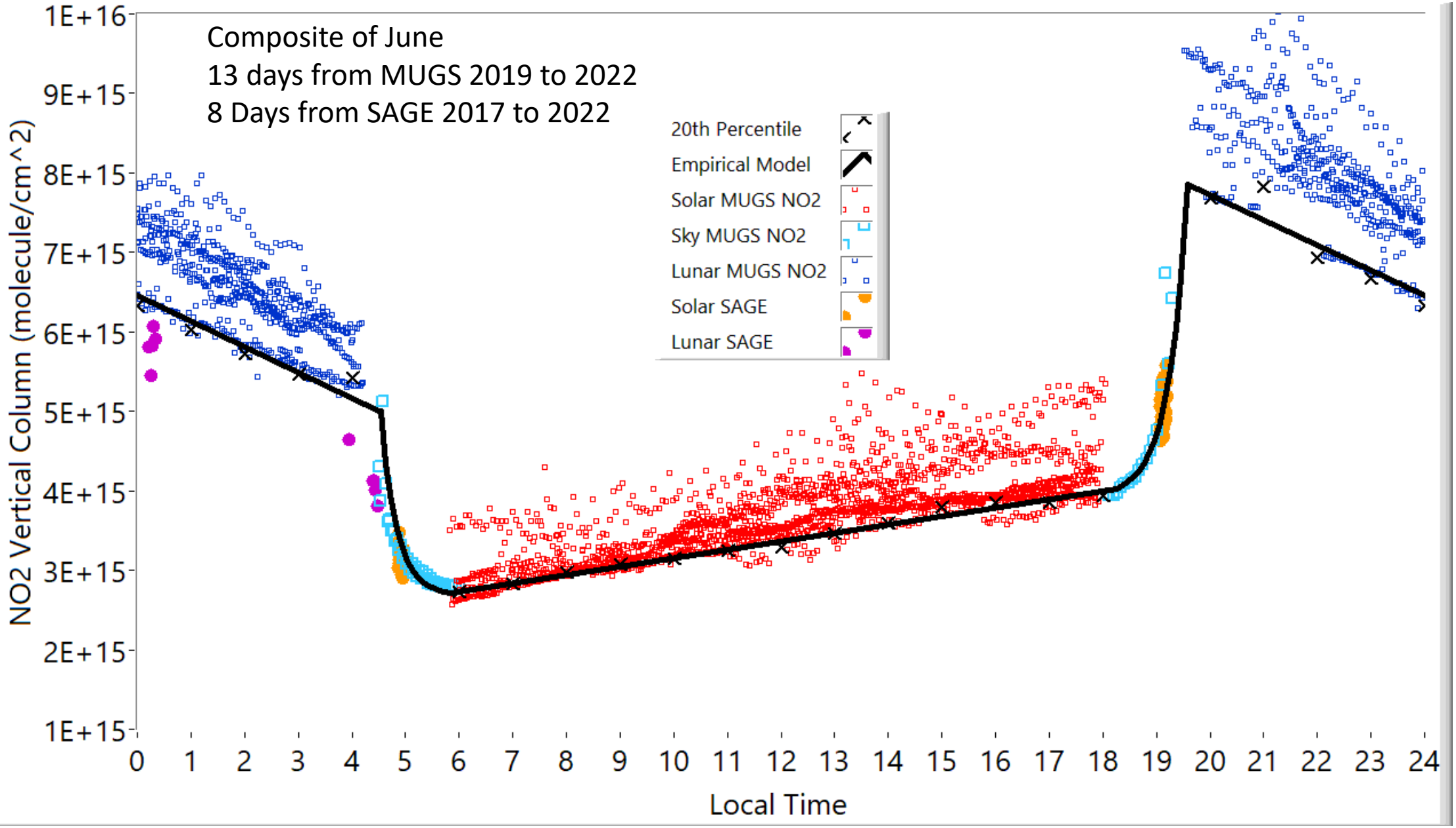


- Exact coincidences between SAGE-III and TMF are infrequent
- We consider coincidences within a global zone from TMF latitude(34.4 °N)
  - $\pm$ 1° for solar and $\pm$ 5° latitude for lunar
- SAGE occultations at other longitudes are converted to TMF local time

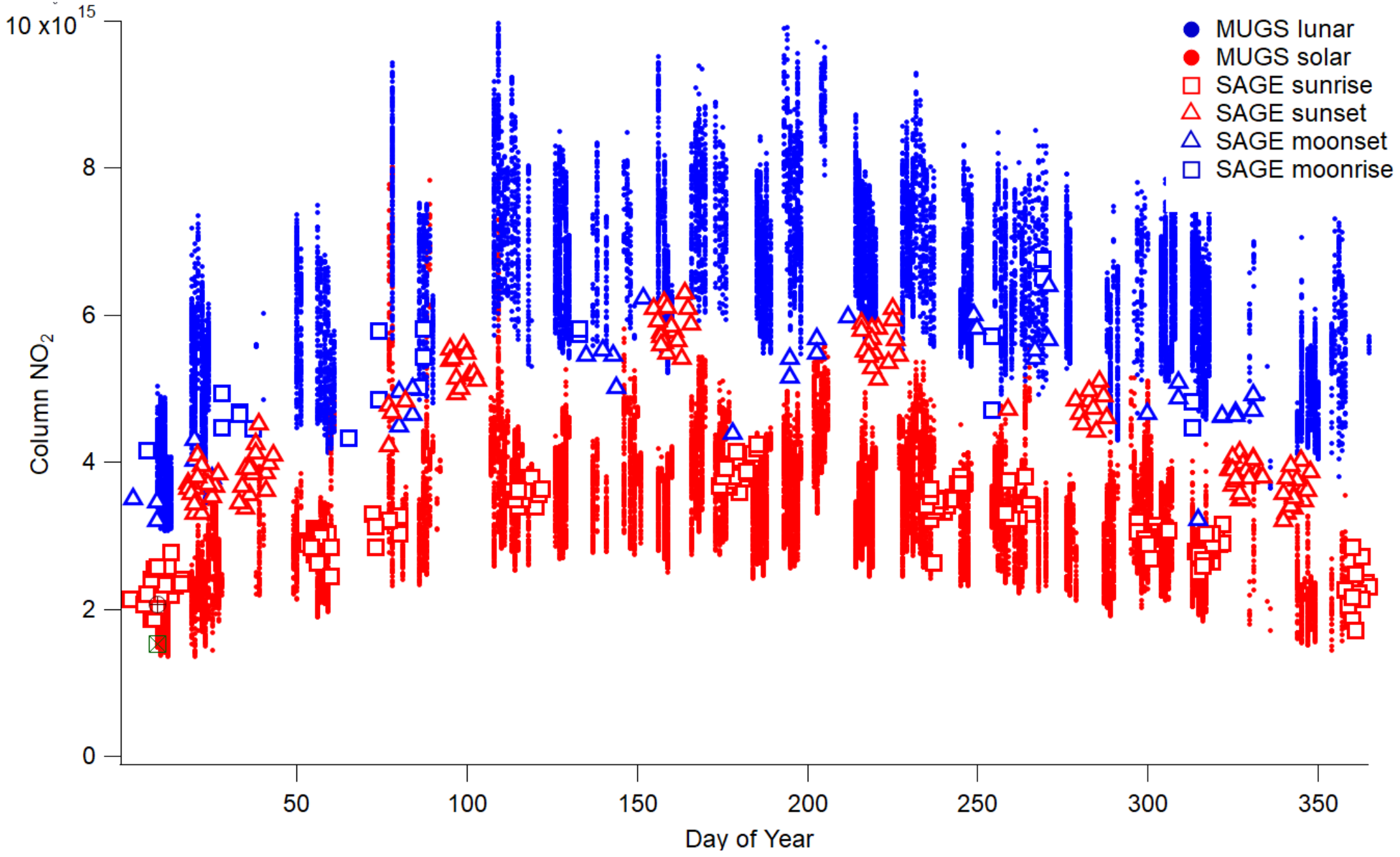
Creating an Empirical Model from the Measurements



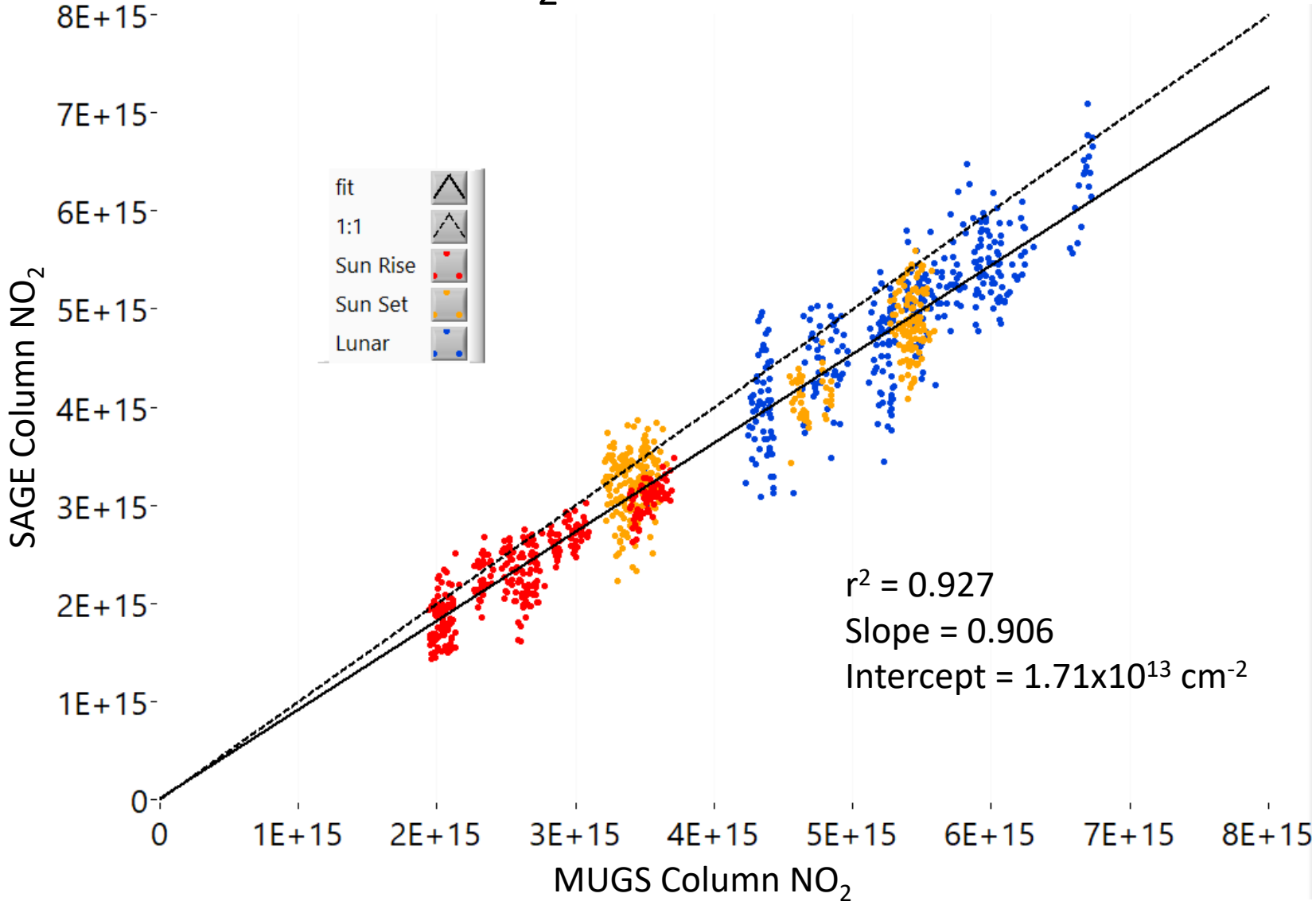
Diurnal Variation of NO_2 Column: SAGE III and MUGS



SAGE-MUGS NO_2 Comparison: year-over-year

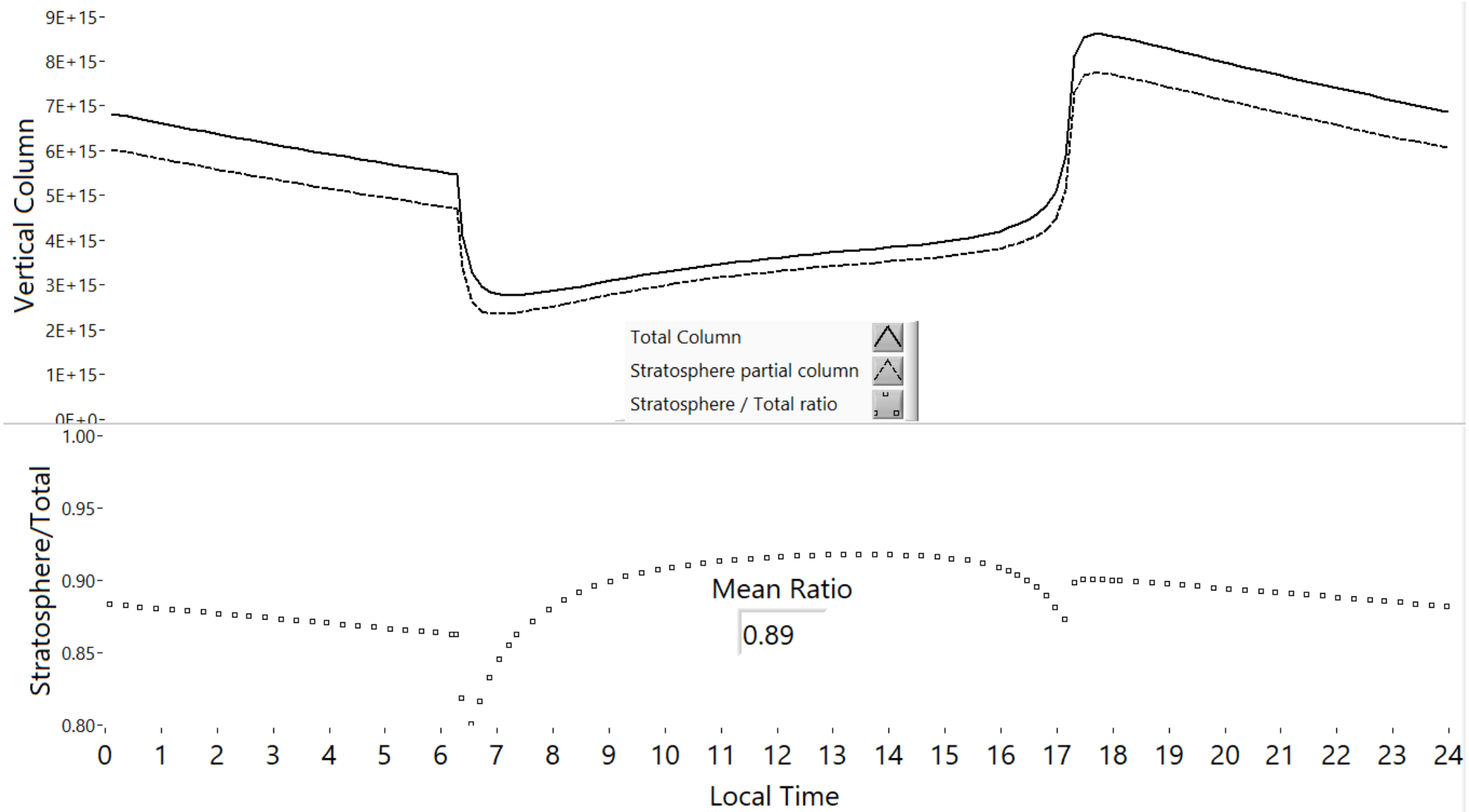


SAGE-MUGS NO_2 Correlation (Solar and Lunar)

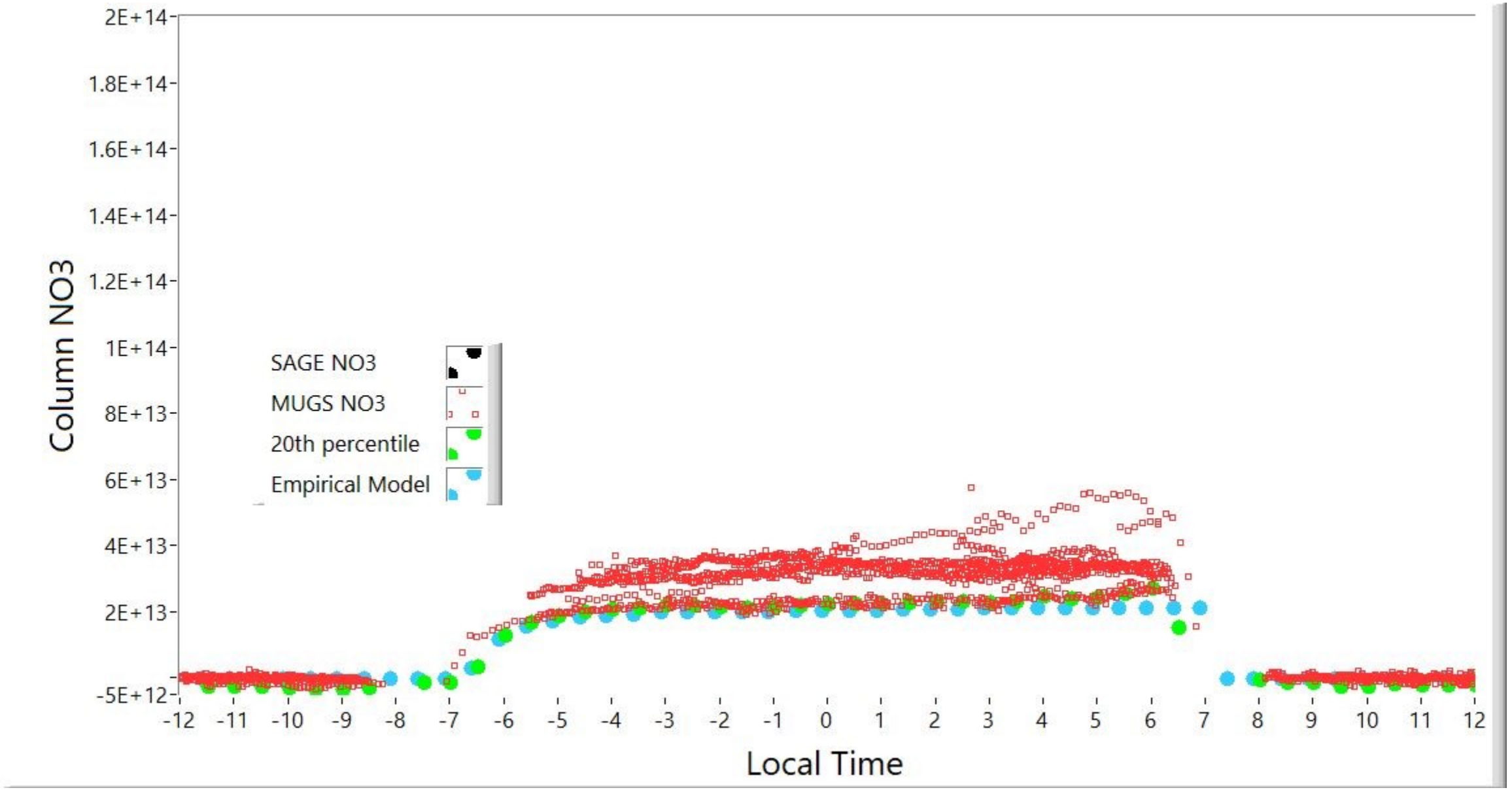


Scatter plot between SAGE-III partial columns (z>17 km and after diurnal correction) and MUGS total column empirical model

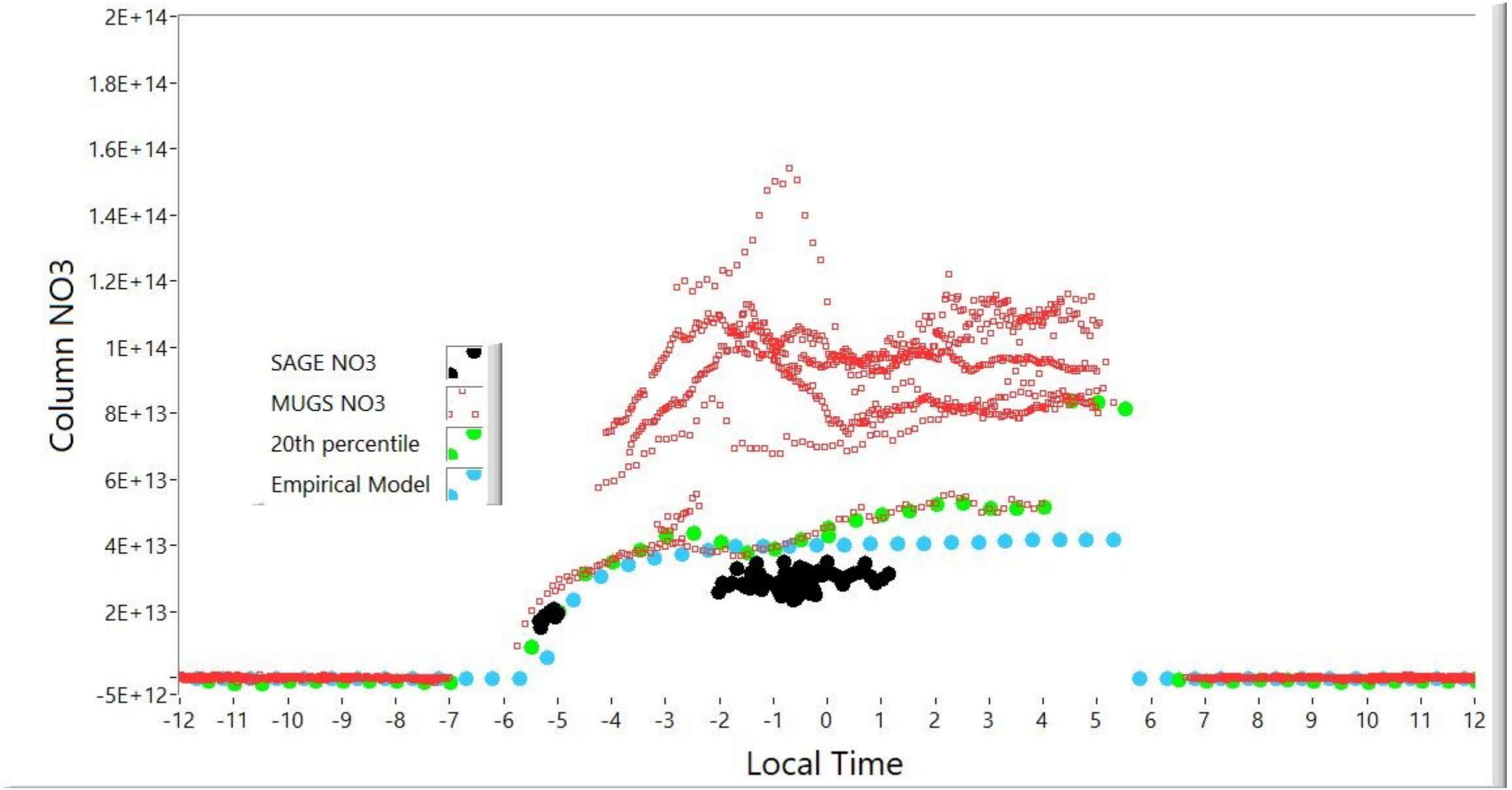
Estimation of partial NO_2 column above 17 km Using the Photochemical Model



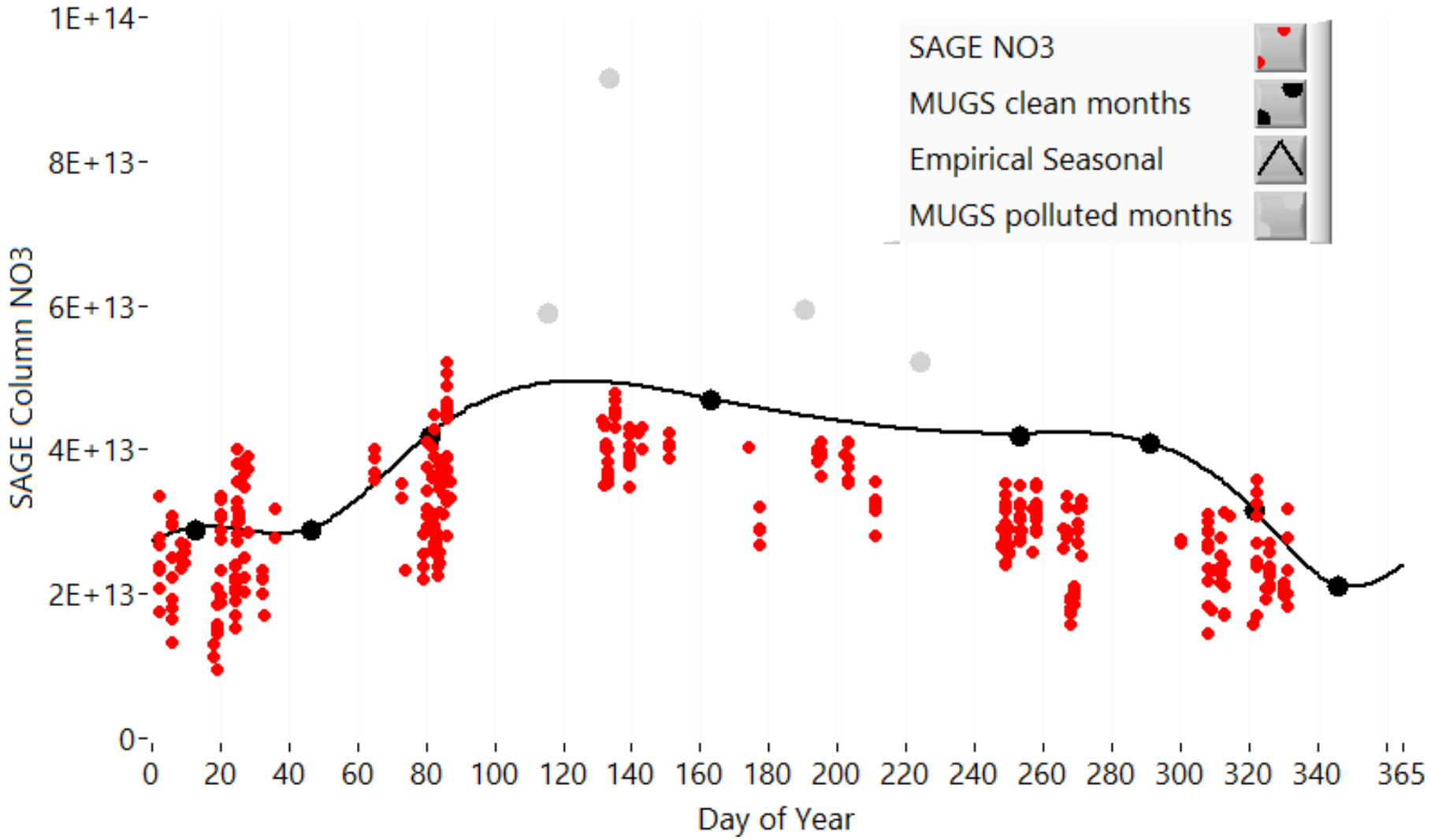
MUGS NO_3 Compilation: December



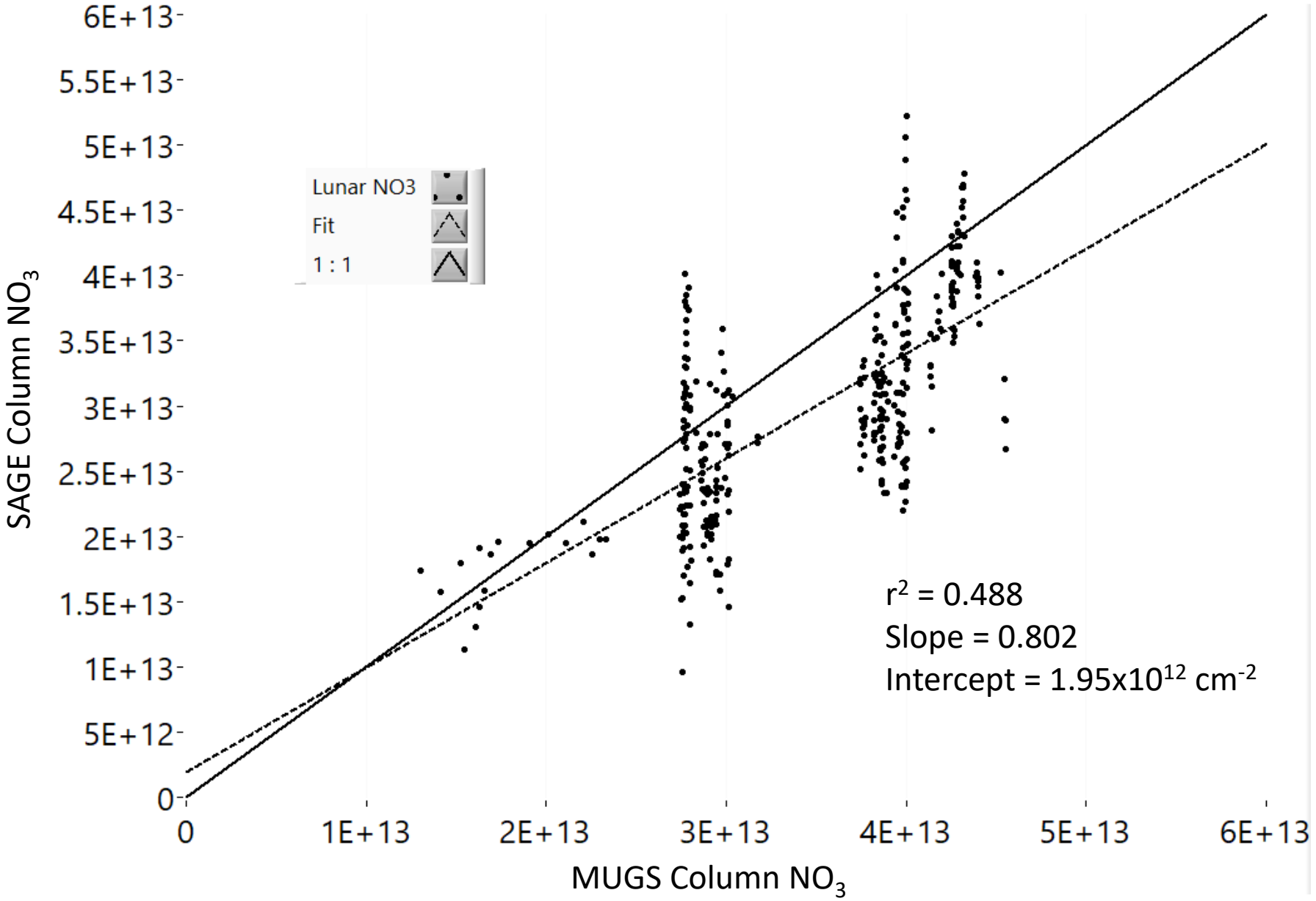
SAGE-MUGS NO_3 Comparison: September



SAGE-MUGS NO_3 Comparison: year-over-year



SAGE-MUGS NO_3 Correlation



Summary

- TMF total column measurements
  - Effects of PBL pollution, diurnal trends, and seasonal variation have been corrected using the entirety of the MUGS data set
- SAGE-III profile measurements are converted to partial column
  - Diurnally corrected data from Latitude bands surrounding TMF collapsed to local time currently provide 1393 individual profiles to compare
- NO_2 shows excellent correlation between the two data sets with SAGE-III being systematically lower by about 10%. This is almost perfectly accounted for by the photochemical model showing the same amount is below 17 km.
- NO_3 has decent correlation to between the two data sets with SAGE-III being systematically lower by about 20%. Further focus on this to come.
- *Future work* will extending the ground-based climatologies and diurnal trends, correcting for FT partial column using more comprehensive model analysis, studying the radiative transfer model to improve ground based measurements of sunrise and sunset. Collection of more direct coincidence measurements.